Hyperintense Carotid Plaque on T_1-Weighted TFE MRI in Symptomatic Patients with Low Grade Carotid Stenosis and Carotid Occlusion

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Introduction

Current management of patients with (symptomatic) carotid atherosclerosis is based on the degree of carotid stenosis, where 70-99% stenosis indicates surgery[1]. In the last decades it has become clear that not only degree of carotid stenosis, but also the presence of a so-called 'vulnerable plaque' is predictive of progression of and subsequent morbidity and mortality from carotid atherosclerosis. This 'vulnerable plaque' can be demonstrated on Magnetic Resonance Imaging (MRI) as a hyperintense plaque representing lipid-rich necrotic core and/or intraplaque hemorrhage[2,3]. So far it has not been clear how many patients with a hyperintense plaque are present within a cohort with low to mild (0-69%) degree of carotid stenosis or carotid occlusion, two subgroups of patients who currently receive only medicinal therapy. In the present study we investigated the prevalence of hyperintense (vulnerable) carotid plaque and its clinical correlates on T_1-weighted turbo-field echo (T_1w-TFE) MRI in patients with varying degrees of stenosis.

Methods

Imaging was performed on a 1.5 Tesla MRI scanner using a SENSE 16-elements NeuroVascular coil. For basic clinical brain imaging, standard sagittal T_1- and transversal dual TSE and T_2 FLAIR images were obtained for assessment of ischemic cerebral lesions. For stenosis grading a 3D CEMRA was acquired during the arterial phase after intravenous injection of gadolinium. Plaque imaging was performed before contrast administration with a T_1w-TFE MRI sequence, acquired of the area around the carotid bifurcation in the transversal plane[4]. A sagittal phase contrast survey image showing the carotid bifurcation was used as a scout image to manually orient the FOV (120x95.6x27mm) around the bifurcation. Imaging parameters were inversion prepulse, TR/TI/TE 10/900/4.2 ms, shot interval time 3000 ms, flip angle 15°, TFE factor 163, matrix size 256 x 163 mm, slice thickness 3mm, no. of slices 9, acquisition time 3.35 min. A hyperintense plaque was assessed by two independent readers and diagnosed if a hyperintense signal (brighter than the adjacent muscle) was seen within the wall or lumen of the ICA in the scanned region around the carotid bifurcation.

Results

Images of 154 patients were assessed. In 28 (18.3%) patients a hyperintense plaque was identified, of which 70% was associated with the symptomatic ICA of the patient; 15.6% of all symptomatic ICAs showed a hyperintense plaque (P = .004). Information on stenosis grade was available for 271 ICAs (88.6%). Most ICAs were assigned to the 0-49% stenosis group (58.3%), followed by 70-99% (27.3%), occlusion (10.3%) and 50-69% (4.1%). There was a significant correlation between stenosis grade and hyperintense plaque (P = .004), with a significantly higher percentage of hyperintense plaques in the 70-99% stenosis group (18.9% versus 7.1%). When categorizing stenosis grade into four ranges (Table II), there were 6 (3.8%) hyperintense plaques seen in arteries with 0-49% stenosis, 4 (36.4%) in arteries with 50-69% stenosis (*Figure*), 14 (18.9%) in arteries with 70-99% stenosis, and 4 (14.3%) in arteries with occlusion.

Conclusion

50% of all hyperintense ICA plaques occur in symptomatic patients presenting with either <70% stenosis or an ICA occlusion. A striking amount of more than one third of patients with 50-69% stenosis presented with a hyperintense plaque. Patients in these stenosis groups with a hyperintense plaque have a relatively higher risk of subsequent ischemic events, and could possibly benefit from aggressive medicinal therapy or revascularization, specifically the group with 50-69% stenosis. Our new finding of hyperintense plaque in carotid occlusion may hypothetically distinguish acute occlusion from chronic occlusion, and may possibly have consequences for future clinical management.

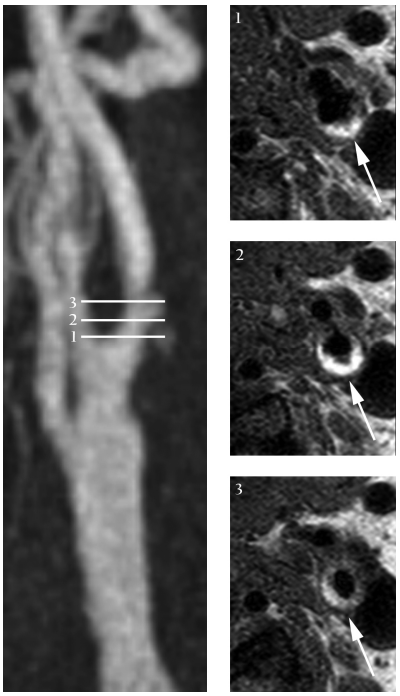

Figure: CEMRA image (left) with 50-69% stenosis; hyperintense plaque (arrows) in ICA on T_1w-TFE MRI (right)

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